

WHAT IS CLAIMED IS:

1. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region and source and drain regions;

a gate insulating film formed on said semiconductor layer;

a first gate electrode formed on said gate insulating film;

a second gate electrode formed on said first gate electrode;

wherein the width of said first gate electrode in the longitudinal direction of said channel forming region is larger than that of said second gate electrode;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween.

2. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region and source and drain regions;

a gate insulating film formed on said semiconductor layer;

a first gate electrode formed on said gate insulating film;

a second gate electrode formed on said first gate electrode;

wherein the width of said first gate electrode in the longitudinal direction of said channel forming region is larger than that of said second gate electrode;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween, and

wherein said channel forming region overlaps with said second gate electrode with said gate insulating film interposed therebetween.

3. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region and source and drain regions;

a gate insulating film formed on said semiconductor layer;

a first gate electrode formed on said gate insulating film, said first gate electrode

having a tapered shape in cross section at an edge portion;

a second gate electrode formed on said first gate electrode;

wherein the width of said first gate electrode in the longitudinal direction of said channel forming region is larger than that of said second gate electrode;

5 wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween, and

wherein said channel forming region overlaps with said second gate electrode with said gate insulating film interposed therebetween.

10 4. A liquid crystal display device according to claim 1, wherein said LDD region is formed in a self-aligning manner in accordance with the addition of an impurity element into said semiconductor layer with said second gate electrode as a mask.

15 5. A liquid crystal display device according to claim 2, wherein said LDD region is formed in a self-aligning manner in accordance with the addition of an impurity element into said semiconductor layer with said second gate electrode as a mask.

20 6. A liquid crystal display device according to claim 3, wherein said LDD region is formed in a self-aligning manner in accordance with the addition of an impurity element into said semiconductor layer with said second gate electrode as a mask.

25 7. A liquid crystal display device according to claim 4, wherein said LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

30 8. A liquid crystal display device according to claim 5, wherein said LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

9. A liquid crystal display device according to claim 6, wherein said LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

10. A liquid crystal display device comprising:

a pixel TFT and a driver circuit TFT, each having a semiconductor layer formed on an insulating surface, a gate insulating film formed on said semiconductor layer, a first gate electrode formed on said gate insulating film, and a second gate electrode formed on said first gate electrode;

wherein said semiconductor layer of said pixel TFT comprises:

a channel forming region overlapping with said second gate electrode with said gate insulating film interposed therebetween;

a first LDD region contacting said channel forming region and overlapping with said first gate electrode with said gate insulating film interposed therebetween;

a second LDD region contacting said first LDD region;

a source region and a drain region contacting said second LDD region, and

wherein said semiconductor layer of said driver circuit TFT comprises:

a channel forming region overlapping with said second gate electrode with said gate insulating film interposed therebetween;

a third LDD region contacting said channel forming region and overlapping with said first gate electrode with said gate insulating film interposed therebetween;

a source region and a drain region contacting said third LDD region, and

wherein the width of said first gate electrode in the longitudinal direction of the channel forming region is larger than that of said second gate electrode.

11. A liquid crystal display device comprising:

a pixel TFT and a driver circuit TFT, each having a semiconductor layer formed on an insulating surface, a gate insulating film formed on said semiconductor layer, a first

gate electrode formed on said gate insulating film, and a second gate electrode formed on said first gate electrode;

wherein said semiconductor layer of said pixel TFT comprises:

a channel forming region overlapping with said second gate electrode with said gate insulating film interposed therebetween;

a first LDD region contacting said channel forming region and overlapping with said first gate electrode with said gate insulating film interposed therebetween;

a second LDD region contacting said first LDD region;

a source region and a drain region contacting said second LDD region, and

wherein said semiconductor layer of said driver circuit TFT comprises:

a channel forming region overlapping with said second gate electrode with said gate insulating film interposed therebetween;

a third LDD region contacting said channel forming region and overlapping with said first gate electrode with said gate insulating film interposed therebetween;

a source region and a drain region contacting said third LDD region, and

wherein said first gate electrode has a tapered shape in cross section at an edge portion, and

wherein the width of said first gate electrode in the longitudinal direction of the channel forming region is larger than that of said second gate electrode.

12. A liquid crystal display device according to claim 10, wherein said first or third LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

13. A liquid crystal display device according to claim 11, wherein said first or third LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

14. A semiconductor display device according to claim 12, wherein said first or third LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

5

15. A semiconductor display device according to claim 13, wherein said first or third LDD region contains a region having a concentration of said impurity element gradient in a range from at least 1×10^{17} to 1×10^{18} atoms/cm³, while increasing as the distance from said channel forming region increasing.

16. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region contacting said channel forming region, and a source region and a drain region contacting said LDD region;

a gate insulating film formed on said semiconductor layer;

a first gate electrode and a first wiring formed on said gate insulating film;

a second gate electrode and a second wiring formed on said first gate electrode and said first wiring respectively;

a first interlayer insulating film formed over said first gate electrode, said first wiring, said second gate electrode and said second wiring;

a second interlayer insulating film formed on said first interlayer insulating film;

an intermediate wiring formed on said second interlayer insulating film and in contact with said first interlayer insulating film through a contact hole formed in said second interlayer insulating film;

wherein the width of said first gate electrode in the longitudinal direction of said channel forming region is larger than that of the second gate electrode;

wherein said channel forming region overlaps with said second gate electrode with said gate insulating film interposed therebetween;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween, and

wherein said intermediate wiring overlaps with said second wiring with said first interlayer insulating film interposed therebetween in said contact hole.

17. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region contacting said channel forming region, and a source region and a drain region contacting said LDD region;

a gate insulating film formed on said semiconductor layer;

a first gate electrode and a first wiring formed on said gate insulating film;

a second gate electrode and a second wiring formed on said first gate electrode and said first wiring respectively;

a first interlayer insulating film formed over said first gate electrode, said first wiring, said second gate electrode and said second wiring;

a second interlayer insulating film formed on said first interlayer insulating film;

an intermediate wiring formed on said second interlayer insulating film and in contact with said first interlayer insulating film through a first contact hole formed in said second interlayer insulating film;

wherein said channel forming region overlaps with said second gate electrode with said gate insulating film interposed therebetween;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween;

wherein said intermediate wiring overlaps with said second wiring with said first interlayer insulating film interposed therebetween in said first contact hole, and

wherein said intermediate wiring is connected to said source region or said drain region through a second contact hole formed in said gate insulating film, said first interlayer insulating film and said second interlayer insulating film.

18. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region contacting said channel forming region,

and a source region and a drain region contacting said LDD region;

a gate insulating film formed on said semiconductor layer;

a first gate electrode and a first wiring formed on said gate insulating film;

a second gate electrode and a second wiring formed on said first gate electrode and

5 said first wiring respectively;

a first interlayer insulating film formed over said first gate electrode, said first wiring, said second gate electrode and said second wiring;

a second interlayer insulating film formed on said first interlayer insulating film;

an intermediate wiring formed on said second interlayer insulating film and in
10 contact with said first interlayer insulating film through a contact hole formed in said second interlayer insulating film;

a shielding film formed on said second interlayer insulating film, said shielding film made from the same material as said intermediate wiring;

wherein said channel forming region overlaps with said second gate electrode with
15 said gate insulating film interposed therebetween;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween;

wherein said intermediate wiring overlaps with said second wiring with said first interlayer insulating film interposed therebetween in said contact hole, and

20 wherein said shielding film overlaps with the channel forming region.

19. A liquid crystal display device comprising:

a semiconductor layer formed on an insulating surface, said semiconductor layer having a channel forming region, an LDD region contacting said channel forming region,

25 and a source region and a drain region contacting said LDD region;

a gate insulating film formed on said semiconductor layer;

a first gate electrode and a first wiring formed on said gate insulating film;

a second gate electrode and a second wiring formed on said first gate electrode and said first wiring respectively;

30 a first interlayer insulating film formed over said first gate electrode, said first

wiring, said second gate electrode and said second wiring;

a second interlayer insulating film formed on said first interlayer insulating film;

an intermediate wiring formed on said second interlayer insulating film and in contact with said first interlayer insulating film through a first contact hole formed in said second interlayer insulating film;

a shielding film formed on said second interlayer insulating film, said shielding film made from the same material as said intermediate wiring;

wherein said channel forming region overlaps with said second gate electrode with said gate insulating film interposed therebetween;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween;

wherein said intermediate wiring overlaps with said second wiring with said first interlayer insulating film interposed therebetween in said first contact hole;

wherein said shielding film overlaps with the channel forming region, and

wherein said intermediate wiring is connected to said source region or said drain region through a second contact hole formed in said gate insulating film, said first interlayer insulating film and said second interlayer insulating film.

20. A liquid crystal display device comprising:

a shielding film formed over a substrate;

an insulating film formed over said shielding film;

a semiconductor layer formed on said insulating film, said semiconductor layer having a channel forming region, an LDD region contacting said channel forming region, and a source region and a drain region contacting said LDD region;

a gate insulating film formed on said semiconductor layer;

a first gate electrode formed on said gate insulating film;

a second gate electrode formed on said first gate electrode and said first wiring respectively;

wherein said channel forming region overlaps with said second gate electrode with said gate insulating film interposed therebetween;

wherein said LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween, and

wherein said shielding film overlaps with said channel forming region with said insulating film interposed therebetween.

5

21. A liquid crystal display device according to claim 20, wherein said insulating film is leveled in accordance with CMP polishing.

22. A liquid crystal display device according to any of claims 1 to 3, 10, 11 and 16 to 20, wherein said liquid crystal display device is incorporated into an electronic equipment selected from the group consisting of a video camera, a digital camera, a projector, a head mounted display, a game apparatus, a car navigation system, a personal computer and a portable information terminal.

10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
350
355
360
365
370
375
380
385
390
395
400
405
410
415
420
425
430
435
440
445
450
455
460
465
470
475
480
485
490
495
500
505
510
515
520
525
530
535
540
545
550
555
560
565
570
575
580
585
590
595
600
605
610
615
620
625
630
635
640
645
650
655
660
665
670
675
680
685
690
695
700
705
710
715
720
725
730
735
740
745
750
755
760
765
770
775
780
785
790
795
800
805
810
815
820
825
830
835
840
845
850
855
860
865
870
875
880
885
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
965
970
975
980
985
990
995

23. A method of manufacturing a liquid crystal display device comprising the steps of:

forming a semiconductor layer on an insulating surface;

forming a gate insulating film on said semiconductor layer;

forming a first conductive film on said gate insulating film;

forming a second conductive film on said first conductive film;

patterning said first conductive film and said second conductive film to a first gate electrode and a second gate electrode;

introducing a first impurity element to said semiconductor layer;

forming a mask over said semiconductor layer so as to cover said first gate electrode and said second gate electrode;

introducing a second impurity element having the same conductivity type as said first impurity element into said semiconductor layer in order to form a channel forming region, a first LDD region contacting said channel forming region, a second LDD region contacting said first LDD region, and a source region and a drain region contacting said second LDD region;

forming an interlayer insulating film over said semiconductor layer, said first gate

electrode, and said second gate electrode;

forming a contact hole in said interlayer insulating film; and

forming a pixel electrode electrically connected to said source region or said drain region through said contact hole,

5 wherein the width of said first gate electrode is larger than that of second gate electrode in the longitudinal direction of said channel forming region;

wherein said channel forming region overlaps with said second gate electrode with gate insulating film interposed therebetween; and

10 wherein said first LDD region overlaps with said first gate electrode with said gate insulating film interposed therebetween.

24. A method of manufacturing a semiconductor display device comprising the steps of:

forming a semiconductor layer on an insulating surface;

forming a gate insulating film on said semiconductor layer;

15 forming a first conductive layer on said gate insulating film, and a second conductive layer on said first conductive layer;

20 etching said first conductive layer and said second conductive layer to form a first gate electrode having a tapered portion and a second gate electrode having a tapered portion;

introducing an impurity element imparting one conductivity type into said semiconductor layer to form a first LDD region and a second LDD region;

introducing an impurity element imparting one conductivity type into said semiconductor film to form a source region and a drain region;

25 forming an interlayer insulating film over said semiconductor layer, said first gate electrode and said second gate electrode;

forming a contact hole in said interlayer insulating film; and

forming a pixel electrode electrically connected to said source region or said drain region through said contact hole.

30 25. A method of manufacturing a semiconductor display device comprising the

steps of:

forming a semiconductor layer on an insulating surface;

forming a gate insulating film on said semiconductor layer;

forming a first conductive film on said gate insulating film;

5 forming a second conductive film on said first conductive film;

etching said second conductive film to form a first shape second conductive layer;

etching said first conductive film to form a first shape first conductive layer;

etching said first shape first conductive layer and the first shape second conductive layer to form a first gate electrode having a tapered portion and a second gate electrode having a tapered portion respectively;

10 introducing an impurity element imparting one conductivity type into said semiconductor layer to form a first LDD region and a second LDD region;

introducing an impurity element imparting one conductivity type into said semiconductor layer to form a source region or a drain region;

15 forming an interlayer insulating film over said semiconductor layer, said first gate electrode and said second gate electrode;

forming a contact hole in said interlayer insulating film; and

forming a pixel electrode electrically connected to said source region or said drain region through said contact hole.